REMARKS

The present application is believed to be in condition at the time of the next Official Action. Reconsideration is respectfully requested.

Claims 14-20 remain pending in the application.

Claims 14-20 were rejected under 35 U.S.C. §112, first paragraph, for not complying with the enablement requirement and for not complying with the written description requirement. These rejections are respectfully traversed for the reasons discussed below.

The Official Action alleged that undue experimentation would have been involved in determining how to practice and use the claimed invention.

The manufacturing process, starting from PET and terminating with light sand-coated PET granules, is illustrated in detail in Figures 1 and 2 of the Appendix following the signature page of this response, to which the following discussion refers. The same process is presented in its essential features in the current claims.

The necessary apparatus and equipment are already available and anyone skilled in the art may carry out the process without undue burden on the basis of the known technology.

The claimed invention concerns a process for the preparation of lightweight PET (polyethylene terephthalate) aggregate that can be used in the manufacture of lightweight

concrete for the building industry, hollow fillings and thermal and acoustic insulation.

By reducing PET material into square shaped flakes(claim 14a illustrated in STEP 1 of Figure 1) that are 1 cm long and subjecting the latter to a thermal and mechanical process to curl and soften the flakes (e.g., the ventilated oven of claim 14b, as illustrated in STEP 2 of Figure 1), double-curvature vault shape flakes are obtained.

Specifically, PET flakes exposed to a temperature between 250°C and 260°C, i.e., below the melting point, will cure and soften to assume the double-curvature vault shape.

In fact, as PET is a non-conductive material, the side of the flake exposed to the heat distends itself and is submitted to tensile stress, and, on the contrary, the opposite side, which is significantly colder, is submitted to compressive stress. As a result of the process, the opposing stresses cause the flake to assume a double-curvature vault shape, and consequently high mechanical strength when it cools.

These shrunken elements obtained are placed in a hemispherical beaker and subsequently exposed to a temperature of less than 250°C. It is important that the flakes are heated at temperatures of 250-260°C, i.e., below the melting point, for a time sufficient for flakes to curl and soften under constant vibration and rotation.

The flakes are subjected simultaneously to vibratory movement, caused by the oscillation of the beaker, and to rotational mechanical movement, induced by the rapid rotation of a fine needle (rotation speed 4 ÷ 6 rounds per second) that spirals within the entire mass of the shrunken elements (e.g., the vibratory and rotational movement of claim 14b as illustrated by STEP 3 of Figure 1). These actions cause the welding of the double-curvature vault shape elements to form hollow spheroidal shaped granules, which, when in the aggregate state, allows them to withstand heavy loads.

The resulting hollow spheroidal shaped granules (**granule type A** of Figures 1 and 2) can for example be employed in civil engineering as loose materials to fill the cavity between internal and external walls allowing better insulation, or to construct French drains near insulated walls.

To improve mechanical properties, the hollow spheroidal shaped granules, as obtained above, are subjected to controlled compression (e.g., as recited in claim 14c, and illustrated by STEP 4 of Figure 2), to obtain spherical shaped granules (**granule type B** of Figure 2). As demonstrated by laboratory tests, if the hollow spheroidal shaped granules are subjected to increasing pressures whilst still hot, it is possible to obtain granules characterized by an increasing compressive strengths. Depending on the degree of compression given to the grains during the

shaping process, different levels of mechanical resistance are obtained (compression stress vanes from 2 N/mm^2 to 4 N/mm^2).

The diameter of the spherical shaped grains typically varies from 10 mm to 25 mm. These granules can be employed to prepare light non-structural concrete for the preparation of:

- insulating thermal and acoustic layers;
- sub-foundation layers;
- light superstructures, thermal and acoustic insulating.

Smaller diameter granules can be used in combination with plaster as non-conductive and insulating material.

The spherical shaped granules described above (**granule type B** of Figure 2) are not completely chemically compatible with the cement paste, therefore to improve the mechanical properties of the material the granules are subjected to surface flaming (e.g., as recited in claim 16d, and illustrated by STEP 5 of Figure 2) whereby they become penetrable to sand. By rolling the hot granules over a bed of fine or coarse sand (e.g., as recited in claim 16d, and illustrated by STEP 6 of Figure 2), the sand can both partially penetrate the granule itself and adhere to the external surface of the granules. As a result of the rapid cooling of the PET, the sand remains permanently within and on the surface of the granules, and aggregates of coated PET granules are obtained (e.g., as recited in claim 16d and claim 18, **granules type C, D** of Figure 2).

Concrete prepared using lightweight PET aggregate according to the current invention is characterized by a low weight to volume ratio and a high compressive strength (approximately 50 MPa, three times above the minimum value requested by Italian Codes) and possesses thermal and acoustic insulating properties.

For illustration purposes, Laboratory Tests on the Lightweight PET Aggregates according to the claimed invention are included in the Appendix, which evaluate the various granules A, B, C, and D discussed above.

Claims 14-15, 17 and 19 were rejected under 35 U.S.C. §103(a) as being unpatentable over BARROW WO 01/55051 ("BARROW") in view of HORNE WO 02/36318 ("HORNE"), as evidenced by the "Polyesters, Thermoplastic" article published by the Encyclopedia of Polymer Science, and claims 16, 18 and 20 were rejected under 35 U.S.C. §103(a) as being unpatentable over BARROW in view of HORNE, as evidenced by the "Polyesters, Thermoplastic" article, further in view of FONG US 6,368,682 ("FONG"). These rejections are respectfully traversed for the reasons discussed below.

There is no suggestion in any of these applied documents that the simultaneously combined vibratory movement, caused by the oscillation of the beaker, and rotational mechanical movement, induced by the rapid rotation of a fine needle that spirals within the entire mass of the shrunken elements (e.g., as recited by claim 14b and illustrated by STEP

3), causes the welding of the double-curvature vault shape elements to form hollow spheroidal shaped granules, which, when in the aggregate state, allows them to withstand heavy loads.

In fact the resulting hollow spheroidal shaped granules (**granule type A** of Figures 1 and 2), are ready for use in civil engineering without any further process, i.e., prior to the compression step of claim 14c.

Another innovative aspect of the present invention, which is not predictable from the combined teachings of BARROW and HORNE, consists in the improvement of mechanical properties enabled by the controlled pressure to which the hollow spheroidal shaped granules are subjected, obtained per the claimed process of 14b, are subsequently subjected (e.g., claim 14c, as illustrated by STEP 4 of Figure 2) thereby obtaining spherical shaped granules (**granule type B**).

In fact, it was found that if the hollow spheroidal shaped granules are subjected to increasing pressures whilst still hot, it is possible to obtain granules characterized by increasing compressive strengths. Depending on the degree of compression given to the grains during the shaping process, different levels of mechanical resistance are obtained. The increase in strength follows a parabolic rather than a linear trend. This is an unique characteristic of this material (i.e. the spherical shaped granule obtained as described above), as no

other light artificial aggregate derived from the same material can be manipulated to obtain a higher mechanical strength.

Thus, there is no suggestion in the cited documents that combining vibratory movement and rotational mechanical movement under heating and followed by the controlled pressure, such positive effects as increased load and mechanical resistance could be obtained.

In addition, it is noted that the purpose of the process regarding surface flaming of granule type B and rolling the hot granules over a bed of fine or coarse sand is not to provide improvement in adhesion, as FONG teaches, but it is aimed at permitting the sand both to penetrate partially the granule itself and to adhere to the exterior surface of the granules. As a result of the rapid cooling of the PET, the sand remains permanently within and on the surface of the granules, and aggregates of coated PET granules are obtained (e.g., as recited in claim 16d and illustrated by **granules type C,D**).

Finally, regarding the "Polyester Thermoplastic" Article published by Encyclopedia of Polymer Science 2002, this document discloses only general features of the material.

Therefore, the claims are not rendered obvious by the proposed combination of documents, and withdrawal of the obviousness rejections is respectfully requested.

In view of the foregoing remarks and the illustration of the claimed invention by the Figures and tests provided in the

appendix, the application is in condition for allowance at the time of the next Official Action. Allowance and passage to issue on that basis is respectfully requested.

The Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 25-0120 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17.

Respectfully submitted,

YOUNG & THOMPSON

Robert A. Madsen, Reg. No. 58,543
209 Madison Street, Suite 500
Alexandria, VA 22314
Telephone (703) 521-2297
Telefax (703) 685-0573
(703) 979-4709

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APPENDIX:

The Appendix includes the following item(s):

- Figure 1 illustrating Steps 1, 2 and 3.
- Figure 2 illustrating Steps 4, 5, 6 and 7.
- Laboratory Tests on Lightweight PET Aggregates of the claimed invention.

Figure 1

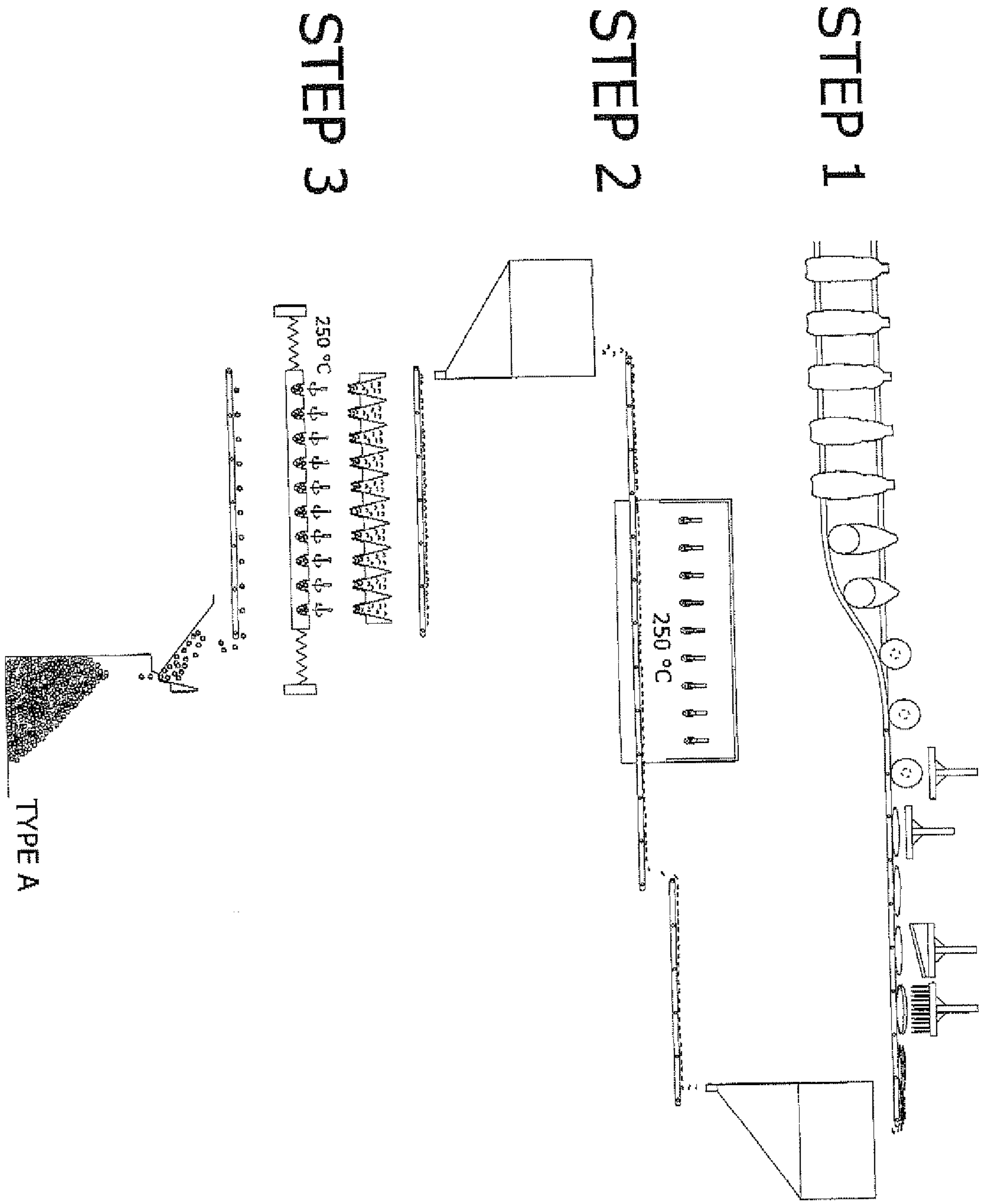
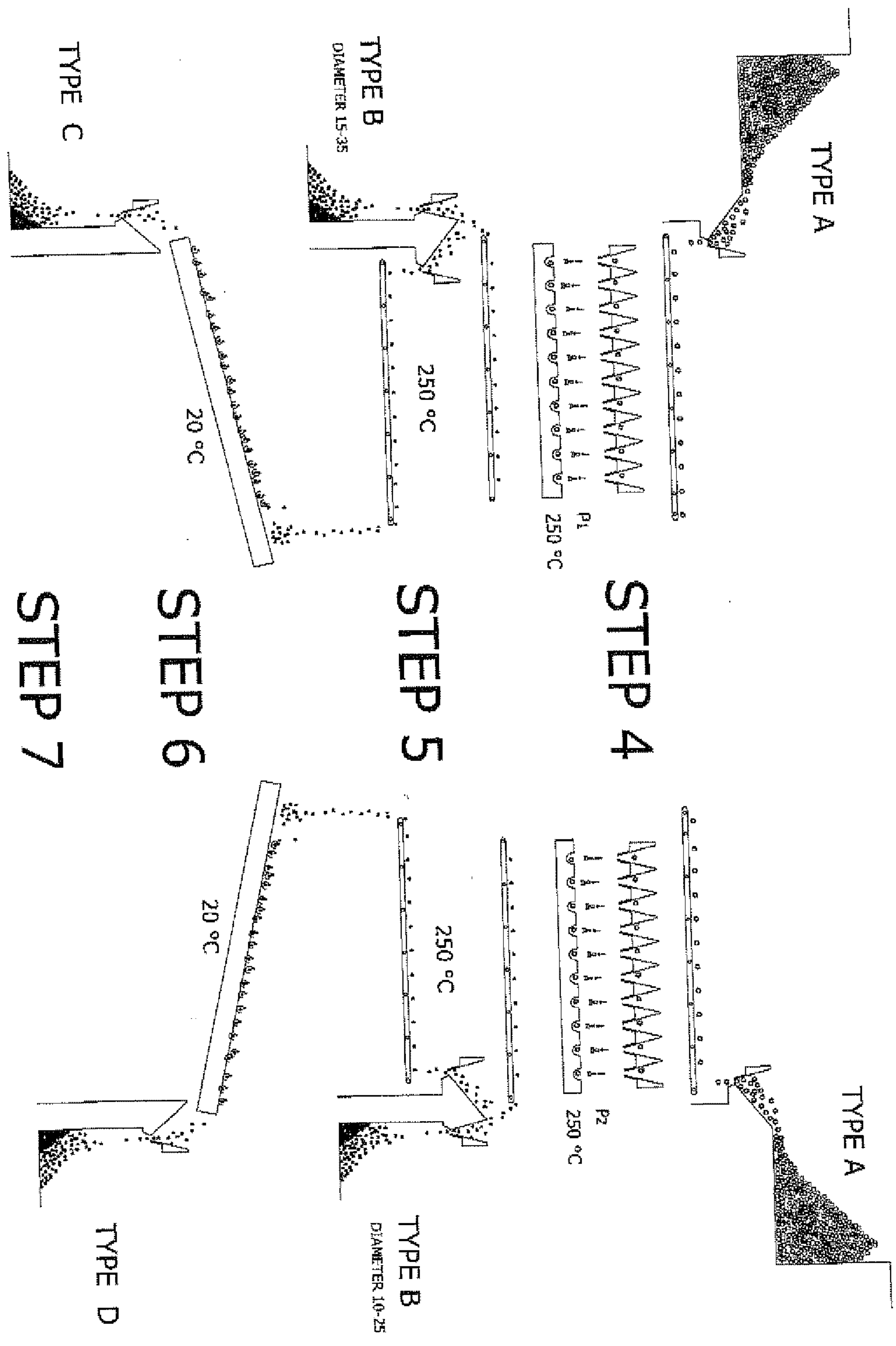


Figure 2


TYPE A
TYPE B
DIAMETER 15-35
TYPE C
P1
250 °C
250 °C
20 °C
STEP 4
STEP 5
STEP 6
STEP 7
TYPE A
P2
250 °C
250 °C
20 °C
TYPE B
DIAMETER 10-25
TYPE D

Laboratory Tests on Lightweight PET Aggregates

Specific laboratory tests carried out on type A granules at GEOLAB srl Laboratory and METRO srl Laboratory (both certified by the Italian Cabinet of Public Works to carry out such tests) show the following values:

- Density 1.400 kg/m^3
- Fusion Temperature 265°C;
- Inflammability Temperature 370°C;
- Auto-ignition Temperature 500°C.

Cylinder samples of type A granules, prepared with the same quantity of flakes but submitted to differing pressures, show increasing values of compressive strength (see Table 1).

Table 1

Number of sample	Reduction of volume(%)	Height (mm) [30 mm]	Volume (mm^3)	Weight (g)	Density (kg/m^3)	Break (N/mm^3)
1	15	26	11752	7.6	646.70	5.5
2	25	22	9944	7.56	760.26	6.8
3	40	18	8362	6.84	817.99	13.8
4	50	15	6780	6.21	915.93	15.3
5	55	13.5	6102	6.03	988.20	18.9

Laboratory Tests on lightweight PET granules for fillings (type A granules)

Table 2

Diameter (mm)	>35
Heap Weight (kg/m^3)	400
Grain Weight (kg/m^3)	560
Surface	Not sanded
Water Absorption	Negligible

Laboratory Tests on lightweight PET aggregate for non-structural concrete (type B granules)

Table 3

Diameter (mm)	15-35
Heap Weight (kg/m^3)	400
Grain Weight (kg/m^3)	560
Surface	Not sanded
Water Absorption	Negligible

Table 4 - Mix design

CEM I 42.5 R	285(kg/m^3)
Aggregate PET (10-20 mm)	429(kg/m^3)
Crusher sand	761 (kg/m^3)
Water	170 (l/m^3)
Superplasticizer	2.9 (l/m^3)
Ratio water/cement	0.6
Consistence	S5
Volume mass	1648(kg/m^3)
Compressive strength (28 dd)	15 MPa

Laboratory Tests on sanded lightweight PET aggregate for structural concrete (type C granules)

Table 5

Diameter (mm)	10-25
Heap Weight (kg/m^3)	570
Grain Weight (kg/m^3)	1050
Surface	Sanded
Water Absorption	Negligible

Table 6 - Mix design

CEM I 42.5 R	285(kg/m^3)
Aggregate PET (10-20 mm)	557 (kg/m^3)
Crusher sand	761 (kg/m^3)
Water	170 (l/m^3)
Superplasticizer	2.9 (l/m^3)
Ratio water/cement	0.6
Consistence	S5
Volume mass	1780(kg/m^3)
Compressive strength (28 dd)	27 MPa

Laboratory Tests on sanded lightweight PET aggregate for structural concrete subjected to high pressure (grain weight 1.390 kg/cm^3-type D granules)

Table 7 - Mix design

CEM I 42.5 R	435 (kg/m^3)
Aggregate PET (10-20 mm)	385 (kg/m^3)
Crusher sand	1088 (kg/m^3)
Water	175 (l/m^3)
Superplasticizer	6.5 (l/m^3)
Ratio water/cement	0.4
Consistence	S5
Volume mass	2090(kg/m^3)
Compressive strength (28 dd)	49.5 MPa